Caries and periodontal disease are the two primary diseases that our profession has to deal with. When I look back at the past 30 years in practice, I would have to say that over the years, periodontitis has been much easier to manage and treat when compared to caries, and a significantly larger proportion of my patients suffer from the ravages of caries when compared to periodontitis. Both periodontitis and caries are basically caused by an imbalance in the bacterial populations of what are natural and normally healthy biofilms. The complexities of the disease we know as caries are the multiple factors that are associated with the evolution of a healthy bacterial biofilm population, to one that is pathological. Caries is an infectious and transmissible disease, and the primary infection can often come from family members or caregivers. Even once all these factors are understood, it is still a significant challenge for many patients to be able to modify their risk factors to create an oral environment that will lead to a re-establishment of a healthy bacterial population within the oral biofilm. The understanding of the behaviour and complexities of biofilms (Fig 1) helps explain the difficulties we are often faced with treating caries at the clinical level.

The surgical excision of demineralized and infected tooth structure does nothing to change the primary caries infection. The pathological biofilm is still present, and unless this is addressed, the patient is going to return in a year or two with further cavities. Treating caries with a focus on risk assessment and management has been shown to be more effective compared to simple restoration of cavities. A healthy biofilm can be made up of over 700 bacterial species, and there can be less than one per cent of potentially pathogenic bacteria within the biofilm which acts as a protective mechanism to help protect the mouth from infection by pathogenic bacteria. Biofilms by their nature are very resistant to change, and when they do change, it usually takes time for the evolution of bacterial species to occur. A change can be caused by modifying pressures from constant overload from pathogenic organisms, external risk factors and risk behaviours. These can all lead to environmental changes within the biofilm that favour the proliferation of aciduric and acidogenic pathogenic species like mutans streptococci and lactobacilli that help them to take over the biofilm. A cariogenic biofilm can then be made up of over 95 per cent pathological bacteria, compared to less than one per cent in a healthy biofilm. When all the factors that may contribute to a biofilm evolution are examined, it appears the primary driver is an acidic pH shift that can be either extrinsic or intrinsic to the dental biofilm, or both.

Depending on the patient’s contributing risk factors, creating a biofilm population shift from a pathological one, back to a healthy
one, can take considerable time and effort. Brushing and flossing breaks up the biofilm, which is an essential factor in caries control. However, this does nothing to change the bacterial species that are present as the biofilm re-establishes itself over the next 12-24 hours. As an analogy I use with my patients, simply mowing a weed-filled lawn does nothing to change the proportion of weeds in the lawn, they are just a bit shorter. Equally, spraying the weeds (using a simple antibacterial mouth rinse) with a weed killer does not prevent new weeds from growing straight back again. We have to do more, like fertilizing the lawn, to help promote the growth of healthy grasses. When treating caries, this analogy means mechanical debridement, using antibacterial rinses, preferably ones that help promote the growth of healthy bacteria, management of foods that promote the production of acid from aciduric bacteria, and the use of rinses that help challenge the acidic environment of a cariogenic biofilm.

Firstly, we need a quick and effective way of clinically testing the dental biofilm for potential pathogenicity. Secondly, we need to be able to effectively educate the patient on the potential consequences of a positive result. Finally, we have to be able to offer patients an effective treatment and management program that they can take home with them.

A common caries management pathway taken at the moment is to detect the symptoms of the disease (cavities), and then simply restore them. However, a patient with high-risk factors, but no current clinical expression of these factors, which may also include a cariogenic biofilm, is simply a patient with a disease that is yet to express its symptoms. Patients much prefer the concept of treating the infection before it has led to the need for a tooth to be drilled. However, this is a complete reversal of the systems that are commonly in place in a practice. To successfully make a change requires planning and education of the staff. On this point, there will be a very good CE course available for both dentists and their staff that will be focusing on risk assessment and treatment for both caries and periodontal disease that is being run by the New Zealand Institute of Minimal Intervention Dentistry in Auckland at the Rendezvous Hotel on Saturday, 17th March 2007 (contact Jenni at thedentists@xtra.co.nz).

Having recently been down this path, I found that the easiest way to change is to start with the end point in mind and work back through the plan to work out how to integrate this into the patient treatment flow. Not only does the dentist need to understand the concepts, but so do the staff, and it is important that the staff have a good knowledge base because the dentist will not have the time to educate all the patients. However, it takes significant time spent on education and systems development to be able to make a successful change in a practice. One of the biggest time consumers can be the education of the patients. To this end, it is essential that the staff are well-trained, as they become an additional source of information transfer. Another very effective way of educating patients can be via a practice newsletter that is sent out as the next examination recall.

What is the reality of instigating a medical approach to diagnosing and treating a biofilm disease rather than waiting for damage to occur to the teeth?
different on their next visit. Experience has shown that this is a very effective way to get detailed information across because most patients do read their dentist’s newsletters. The more information given to patients prior to their dental visits, the less chair-time will be needed to explain caries risk assessment and its benefits to them.

This article is in no way meant to be an ‘advertorial’ but, from personal experience, I have found that changing systems, or introducing new concepts into a busy practice can be very difficult. Oral Biotech, an Oregon dental company, has developed a caries screening and treatment system (Canfree) that allows easy integration into the practice because all the normal ‘sticking points’ in making big changes have been recognized and systematized to aid in the rapid integration of an effective caries management program into a busy practice schedule. It was the simple “plug and play, caries management in a box” concept that so attracted me to it. I had been trying to develop an effective caries management program, but was not having great success in integrating the concepts into my daily routines. There are three aspects to the Oral Biotech Canfree system: dentist and staff education, a simple biofilm screening test, and a basic biofilm treatment program that can be modified with additional products, as required, to target certain risk factors in high and extreme-risk patients.

Identifying a Pathological Biofilm

Risk assessment requires standardized risk assessment forms, educational material that will educate patients on risk factors and protective factors and how a disturbance of the balance can lead to a cariogenic biofilm developing, and finally, a simple screening test. There are currently three ways available for assessing the cariogenicity of a biofilm.

1. The Vivident CRT bacterial culture kit
   This is a 48-hour bacterial culture to measure the colony-forming units of planktonic (free floating) Mutans Streptococci (MS) and Lactobacilli (LB) in a patient’s saliva. This requires the patient to chew on wax for five minutes, then spit into a cup to collect the saliva which is then flowed over the double-sided agar plate and incubated for 48 hours (Fig 2).

2. The Plaque Check+pH test kit from GC
   This is a relatively simple five-minute chair-side test kit that measures the change in plaque pH when it is exposed to sugar. The change in plaque pH after five minutes gives an indication of the potential cariogenicity of the plaque bacteria (Fig 3). This test gives a more accurate indication of biofilm cariogenicity because it allows different areas of biofilm to be tested, whereas the CRT test is simply measuring salivary levels of planktonic MS and LB bacteria shed from the overall oral biofilm.
3. The Cariscreen test from Oral Biotech

This is a simple screening test of the dental biofilm that takes less than a minute. It utilizes a completely different concept to measure the potential pathogenicity of dental plaque. Acidophillic and acidic bacteria are able to survive in a low pH environment because of their ability to maintain a neutral intra-cellular pH via an efficient cell wall hydrogen ion pump that removes hydrogen ions as they diffuse from the extra-cellular, high pH environment, back through the cell wall. This protective mechanism requires significant amounts of energy which is derived from mitochondrial ATP. The Cariscreen test measures dental biofilm ATP levels by mixing the bacterial ATP with luciferin which then produces a quantifiable level of light. The light output (Relative Light Units) has been calibrated to known pathogenic bacterial standards. The object of the test is to be able to screen a patient’s plaque in real time (Fig 4). If a positive result is obtained, the screening test is then confirmed using a 24-hour bacterial culture for Mutans Streptococci (Fig 5). Cariscreen has a sensitivity and specificity in excess of 90 per cent.

However, simply diagnosing a cariogenic biofilm is of little significance if a practical solution is not able to be offered to the patient.

The treatment of a cariogenic biofilm can be very complex due to the multi-factorial aspects of the disease, and the protocols presented to patients, based on their diagnosed needs, has to be simple and practical otherwise very few patients will persevere to the point that they have success.

The basic concepts in managing a biofilm disease are firstly physical disruption of the biofilm mass. If this is not done, antibacterial rinses will have little or no effect on the biofilm which develops in such a way that it can resist serious attack from antibacterial agents. Ideally, the rinse should also be able to attack the physical structure of a dental biofilm which is made up of approximately 85 per cent extra-cellular mucopolysaccharides to help expose the bacteria to the antibacterial agent. There are several effective broad spectrum antibacterial agents: isopropyl alcohol, gluteraldehyde and sodium hypochlorite, ozone and chlorine dioxide - to name a few. However, alcohol, gluteraldehyde and ozone cannot be used safely as a total mouth rinse. Sodium hypochlorite is very effective in its effects on a biofilm in that it challenges the bacteria as well as the physical mucopolysaccharide structure of the biofilm. A further desirable attribute of a mouth rinse would be for it to have a pH greater than 7.13,14 We focus on low pH drinks and foods that help create a low pH oral environment that can aid in the development of a cariogenic biofilm, yet we get patients to use oral rinses that have can have a significantly low pH. Some rinses are as low as pH4 and very few are above pH7. For high-risk patients, it is recommended they rinse regularly with water containing baking soda to help raise the intraoral pH; so it makes sense that an antibacterial rinse would also have this ability. The sodium hypochlorite used in the treatment phase of the Carifree system is not only strongly antibacterial and broad spectrum, it also has a pH of 10.3.

When we accept we all have to have a biofilm in our mouths, the concept of trying to permanently kill off the bacteria makes no sense. We have to be trying to work with Mother Nature, rather than fight her in an un-winnable fight. One conceivable approach would be to seriously challenge the bacteria in a pathological biofilm for a short period, and then create an environment that would be conducive to the re-establishment of a biofilm containing more non-pathogenic bacteria. This is done using several strategies. The first is the modification of patient risk factors and risk behaviours including reduction in sugar and acid exposure to reduce the frequency of acid attacks on the enamel.15,17 Without risk modification, nothing else will succeed, so it is essential patients are well-educated with regard to this. Following a strong antibacterial challenge for several days, the next step would be to create an oral environment with a pH above 7 that was also conducive to the proliferation of non-pathogenic bacteria. The use of Xylitol,18,20 fluoride,21-23 and naturally occurring antibacterial agents like polyphenols24-25 and anthocyanadins26-27 in a rinse with a pH8 is designed to do just this. In the case of high-risk patients, particularly those that exhibit low resting salivary pH, a mouth spray containing fluoride and Xylitol with a pH9 associated with CaOH, can be used on a regular basis throughout the day. The goal is to make it as easy as possible for patients to comply with our recommendation. I have yet to find many patients that think it convenient to carry around a litre of water containing dissolved baking soda, so they can sip it on a regular basis. In high-risk patients, the addition of high fluoride toothpaste and CPP-ACP paste can further enhance the pressure on a pathological biofilm.

The use of fluoride and chlorhexidine in a caries control regime is difficult because patients have to use the products at different times due to the problems associated with combining cationic and anionic agents simultaneously. As soon as a management regime becomes complicated, patient compliance diminishes. The Carifree system does not have the problems associated with the combination of various products and is essentially compatible with any other ancillary products that may be required for high and extreme-risk patients. These may include the use of Xylitol...
and CCP-ACP containing chewing gums, fluoride varnish, Tooth Mousse and high F dentifrice.

Case Study

When I first gained access to the Carifree treatment and maintenance rinses in February 2004, I used them in conjunction with the Vivadent CRT test to assess their efficacy in helping modify a cariogenic biofilm.

A 14-year-old female presented with 14 cavities in her posterior dentition, some were near exposures (Fig 6,7).

A baseline CFU for MS and LB was established using the CRT test (Fig 8).

The patient was then placed on the Carifree Tx rinse bid for two weeks, followed by the maintenance rinse bid for three weeks. This cycle was then repeated. Her risk factors were identified via a standardized questionnaire, and she was then educated as to what she needed to do to minimize her risk. Her risk factors were relatively simple in that they were primarily poor oral hygiene and excessive exposure to sugar between meals via drinks and sweets. She was taught how to clean and floss well.

Following three months on the rinse cycle and completion of three of the quadrants of dentistry, the CRT test was still ‘moderate’ in terms of the CFU score (Fig 9). This was possibly due to continual recontamination of the mouth from the cavities in the un-restored quadrant. Following completion of the restorations, the patient was placed on a final cycle of the Carifree treatment and maintenance rinses, and the CFUs then reassessed (Fig 10).

This low-risk result with a CFU score <10^6 was very encouraging, indicating she was successfully addressing her risk factors and oral hygiene. In conjunction with the
Carifree rinses. her biofilm had recovered to a healthy state. She continues to maintain this state.

Using this system, I have had encouraging success in helping many of my high-risk patients, who in the past have not been able to control their infection based on the use of chlorhexidine, fluoride, diet control and good oral hygiene.

Conclusion

A semantics tangle in dentistry has made the discussion of caries very difficult because we use the term caries to synonymously describe a biofilm disease and cavities in teeth. Caries, the biofilm disease, cannot be treated surgically, which is what the primary focus has been in the past. As a profession we need to make a conscious effort to address the disease as well as the symptoms. We are experts at treating caries symptoms and their ongoing consequences, and now need to become as effective and efficient at managing the actual disease.

The challenge for practitioners today is that there remains no known documented one-size-fits-all, formula for treating dental caries. The simple one-size-fits-all therapy may work well with a single pathogen disease model but may have only limited effectiveness with a multifactorial/multipathogenic biofilm-based disease model. As our understanding of the complexities of the disease process improves, new techniques and materials are becoming available to aid in improving our ability to help our patients manage their disease, focusing on treatment strategies targeted to specific risk factors uniquely designed for each individual patient. As caregivers, we all respond to change and are motivated most when it is in the best interest of the people we serve. Once effective caries management is in place, both the dentist and the patients feel more comfortable with the prospect of accepting advanced restorative procedures because there is a confidence that recurrent cavitation associated with an untreated pathological biofilm will not compromise the longevity of the restorative work. The hardest part has been making the change from a surgical model to a medical model of caries management and treatment.

Disclosure

Graeme Millichich has purchased shares in Oral Biotech, producers of the Biotech Carifree system.

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References